

## CLAIMS

What is claimed is:

1. A method for processing substrate to form a semiconductor device, said substrate including an etch stop layer disposed above a metal layer, comprising:  
etching through said etch stop layer, using a plasma etch process that utilizes a chlorine-containing etchant source gas, thereby forming etch stop layer openings in said etch stop layer, said etch stop layer including at least one of a SiN and SiC material; and thereafter performing a wet treatment on said substrate, said wet treatment including a rinse using a solution that contains acetic acid ( $\text{CH}_3\text{COOH}$ ).
2. The method of claim 1 wherein said metal layer represents a copper-containing metallization layer.
3. The method of claim 2 wherein said substrate further includes a dielectric layer disposed above said etch stop layer.
4. The method of claim 3 wherein a material of said dielectric layer has a dielectric constant of less than 4.
5. The method of claim 4 wherein said etching through said etch stop layer is performed through dielectric layer openings in said dielectric layer.
6. The method of claim 3 wherein said etching through said etch stop layer is performed through dielectric layer openings in said dielectric layer.
7. The method of claim 1 wherein said etch stop layer includes said SiC material.
8. The method of claim 1 wherein said solution further includes ammonium hydroxide ( $\text{NH}_4\text{OH}$ ).
9. The method of claim 8 wherein said ammonium hydroxide concentration is between about 0.5 % and about 10% by volume.

10. The method of claim 9 wherein said acetic acid concentration is between about 1 % and about 99.5% by volume.

11. The method of claim 1 wherein said acetic acid concentration is between about 1 % and about 99.7% by volume.

12. The method of claim 1 further including performing one of a de-ionized water rinse and a HCl dip/de-ionized water rinse on said substrate prior to said wet treatment.

13. A method for performing a dual damascene process on a substrate, said substrate including a dielectric layer disposed above an etch stop layer, said etch stop layer being disposed above a metal layer, comprising:

performing plasma etching through said dielectric layer using a first etchant source gas to form a plurality of dielectric-layer openings;

performing plasma etching through said etch stop layer, using a second etchant source gas different from said first etchant source gas, said second etchant source gas including chlorine, thereby forming etch stop layer openings in said etch stop layer, said etch stop layer including at least one of a SiN and SiC material;

thereafter performing a wet treatment on said substrate, said wet treatment including a rinse using a solution that contains acetic acid ( $\text{CH}_3\text{COOH}$ ).

14. The method of claim 13 wherein said metal layer represents a copper-containing metallization layer.

15. The method of claim 14 wherein a material of said dielectric layer has a dielectric constant of less than 4.

16. The method of claim 15 wherein said etch stop layer includes said SiC material.

17. The method of claim 13 wherein said solution further includes ammonium hydroxide ( $\text{NH}_4\text{OH}$ ).

18. The method of claim 17 wherein said ammonium hydroxide concentration is between about 0.5% and about 10% by volume.
19. The method of claim 18 wherein said acetic acid concentration is between about 0.5% and about 99.5% by volume.
20. The method of claim 13 wherein said acetic acid concentration is between about 1 % and about 99.7 % by volume.
21. The method of claim 13 further including performing one of a de-ionized water rinse and a HCl dip/de-ionized water rinse on said substrate prior to said wet treatment.
22. The method of claim 21 wherein a material of said dielectric layer has a dielectric constant of less than 4.
23. The method of claim 13 further including performing a HCl dip/de-ionized water rinse on said substrate prior to said wet treatment.
24. The method of claim 13 wherein said plasma etching through said etch stop layer is performed in a capacitively-coupled plasma processing system.
25. The method of claim 13 wherein said plasma etching through said etch stop layer is performed in an inductively-coupled plasma processing system.
26. A method for processing substrate to form a semiconductor device, said substrate including an etch stop layer disposed above a metal layer, comprising:  
etching through said etch stop layer, using a plasma etch process that utilizes a chlorine-containing etchant source gas, thereby forming etch stop layer openings in said etch stop layer, said etch stop layer including at least one of a SiN and SiC material;  
thereafter performing a rinse on said substrate, said rinse using a rinsing solution that includes de-ionized water; and  
thereafter performing a H<sub>2</sub> plasma treatment on said substrate.

27. The method of claim 26 wherein said metal layer represents a copper-containing metallization layer.
28. The method of claim 27 wherein said substrate further includes a dielectric layer disposed above said etch stop layer.
29. The method of claim 28 wherein said etching through said etch stop layer is performed through dielectric openings in said dielectric layer.
30. The method of claim 28 wherein a material of said dielectric layer has a dielectric constant less than 4.
31. The method of claim 26 wherein said etch stop layer includes said SiC material.
32. The method of claim 22 wherein said chlorine-containing etchant source gas includes an inert gas, said inert gas including at least one of Ar, He, Ne, Kr, and Xe.
33. The method of claim 26 further including performing one of a de-ionized water rinse and a HCl dip/de-ionized water rinse on said substrate prior to said wet treatment.
34. The method of claim 26 wherein said plasma etching through said etch stop layer is performed in a capacitively-coupled plasma processing system.
35. The method of claim 26 wherein said plasma etching through said etch stop layer is performed in an inductively-coupled plasma processing system.
36. A method for processing substrate to form a semiconductor device, said substrate including an etch stop layer disposed above a copper metal layer, comprising:  
etching through said etch stop layer, using a plasma etch process that utilizes a chlorine-containing etchant source gas, thereby forming etch stop layer openings in said etch stop layer, said etch stop layer including at least one of a SiN and SiC material; and  
thereafter passivating said copper metal layer through said etch stop layer openings with a passivating solution that includes benzotriazole(BTA).

37. The method of claim 36 wherein said substrate further includes a dielectric layer disposed above said etch stop layer.
38. The method of claim 37 wherein a material of said dielectric layer has a dielectric constant less than 4.
39. The method of claim 37 wherein said etching through said etch stop layer is performed through dielectric layer openings in said dielectric layer.
40. The method of claim 39 wherein said etch stop layer includes said SiC material.
41. The method of claim 36 further including performing a wet chemical treatment on said substrate prior to said passivating, said wet chemical treatment employing a solution that includes an organic acid or a mixture of an organic acid and a hydroxide.
42. The method of claim 41 wherein said organic acid is acetic acid.
43. The method of claim 41 wherein said hydroxide is ammonium hydroxide.
44. The method of claim 41 further including performing one of a de-ionized water rinse and a HCl dip/de-ionized water rinse on said substrate prior to said wet chemical treatment.
45. The method of claim 36 further including performing a H<sub>2</sub> plasma treatment on said substrate prior to said passivating.
46. A method for processing substrate to form a semiconductor device, said substrate including an etch stop layer disposed above a metal layer, comprising:  
etching through said etch stop layer, using a plasma etch process that utilizes a chlorine-containing etchant source gas, thereby forming etch stop layer openings in said etch stop layer;  
and  
thereafter performing a wet treatment on said substrate, said wet treatment including a rinse using a solution that contains acetic acid (CH<sub>3</sub>COOH).

47. A method for processing substrate to form a semiconductor device, said substrate including an etch stop layer disposed above a metal layer, comprising:

etching through said etch stop layer, using a plasma etch process that utilizes a chlorine-containing etchant source gas, thereby forming etch stop layer openings in said etch stop layer;

thereafter performing a rinse on said substrate, said rinse using a rinsing solution that includes de-ionized water; and

thereafter performing a H<sub>2</sub> plasma treatment on said substrate.

48. A method for processing substrate to form a semiconductor device, said substrate including an etch stop layer disposed above a copper metal layer, comprising:

etching through said etch stop layer, using a plasma etch process that utilizes a chlorine-containing etchant source gas, thereby forming etch stop layer openings in said etch stop layer;

and

thereafter passivating said copper metal layer through said etch stop layer openings with a passivating solution that includes benzotriazole(BTA).